AbstractID: 3458 Title: Combined Scatter Subtraction and Digital Restoration of Ho-166 Images for Quantification

Purpose: Ho-166-DOTMP used as targeted radiotherapy to the skeleton has shown great potential for treating multiple myeloma with improved therapeutic index. Potential kidney toxicity has suggested quantification of kidney activity in treatment planning. This has been limited by poor image quality, due to low abundance of imaging photons and relatively high septal penetration of 1.4-MeV photons. Scatter subtraction techniques have been limited because of poor counting statistics after subtraction. We explored the combination of digital restoration and scatter subtraction for Ho-166 image.

Method and Materials: A medium-energy collimator was used as a compromise to maximize sensitivity and reduce septal penetration. One photon-window (81-keV) and 2 scatter-windows (lower: 57-73 keV, upper: 89-105 keV) were acquired on a Philips camera with a ¾inch crystal. Images were first subtracted with upper-scatters as energy spectrum from 1.4-MeV photons was flat. Digital restoration was used instead of further subtracting lower scatters. The line-spread function (LSF) was obtained from a subtracted image to determine the modulation transfer function (MTF) at 10-cm depth. Object power spectrum of the Wiener filter was estimated from image power spectrum of Tc-99m-DTPA and Ho-166-DOTMP of the same patient.

Results: An upper-scatter subtraction-fraction of 1.0 was confirmed by assessing LSF in air. Subtraction of upper-scatter before Wiener filtering is necessary to remove various image artifacts due to 1.4-MeV photon penetration. The maximum response of the Wiener filter was 2 at 0.08 cycle/pixel and response was decreased to 0.1 at 0.25 cycle/pixel. Image degradation (FWTM) was reduced from 80-mm to 50-mm. Image counting statistics were improved as the total image counts were increased 30% after scatter subtraction and wiener filtering for kidney image 4-6 hour post injection.

Conclusion: Combined upper-scatter subtraction and digital restoration improves image quality, allowing quantification of kidney activity with adequate counting statistics to obtain reliable data.